



## AVIONIC SYSTEMS DIVISION

NASA JSC/EV41/P. Fink

13 Feb., 2003

# Endothelium Preserving Microwave Treatment for Atherosclerosis

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## Background

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- Our primary focus is on antennas and electromagnetic systems
- We recently developed and licensed a microwave catheter antenna for cardiac arrhythmias
- We have developed catheter antennas and a system intended for treatment of atherosclerosis





## Major Technical Challenges

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- Efficient transfer of energy through a small catheter
- High frequencies (short wavelength) due to restricted artery region
- Small, efficient antenna with directionality
- Verification of thermal profile
  - ◆ numerical simulation
  - ◆ relies on accurate knowledge of material properties
- Clinical testing



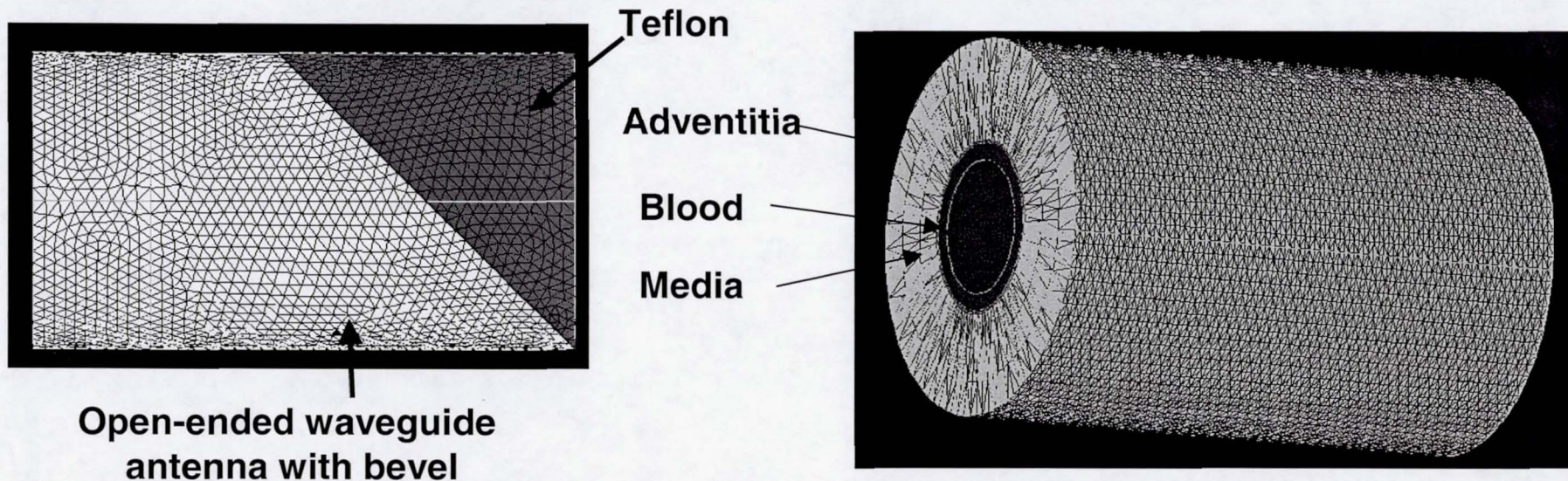


# Technology Description

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Microwave catheter antenna for heating atherosclerotic lesions to reduce constriction in the artery

- ◆ Antenna directionality focuses energy to lesions





## R&D Status

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- Current level of development
  - ◆ Prototyped 2 directional catheter antennas specifically for atherosclerotic treatment
    - ✓ Open-ended waveguide with bevel (patented)
    - ✓ New directional catheter antenna
      - in disclosure process
  - ◆ Preliminary computational electromagnetic modeling (CEM) of new directional catheter antenna
  - ◆ Preliminary simulations of thermal profiles using candidate frequencies, power levels, and heating times
  - ◆ Performed initial test of energy transfer to lipids



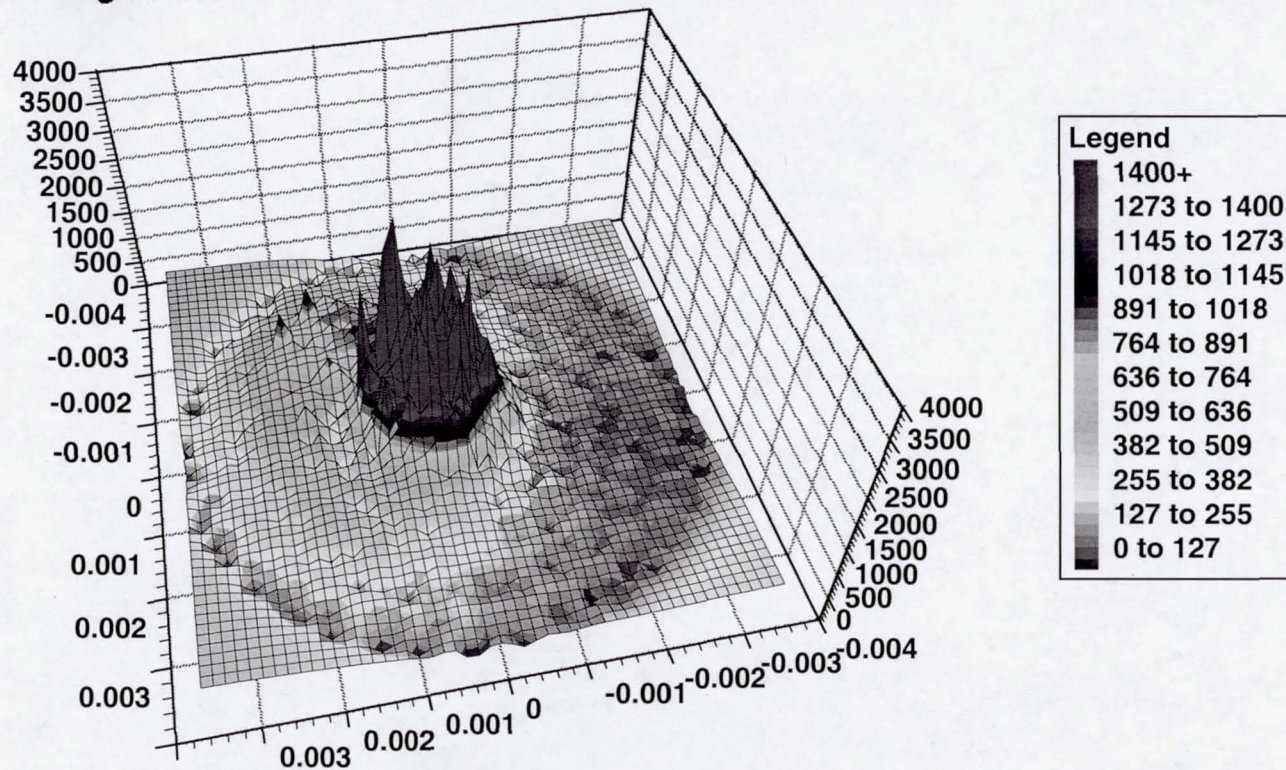


# New Catheter Antenna

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- Initial CEM simulation
  - ◆ Ez near feed region
  - ◆ Simplified infinitesimal current filament source
    - ✓ Demonstrates front/back directionality





## Development Hurdles

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- Comprehensive test program with partner in the medical community
- Verify preservation of intima while supplying sufficient heat to atherosclerotic region



## Competing Technologies

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- Balloon angioplasty
- stents
- Laser ablation





## Comparison with Existing Technologies

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- Disadvantages of current methods
  - ◆ Balloon angioplasty
    - ✓ Restenosis
  - ◆ stents
    - ✓ Restenosis in older, non-coated stents
  - ◆ Laser ablation
    - ✓ Possible destruction of artery





## Comparison with Existing Technologies

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- Advantages of proposed method
  - ◆ We anticipate this method will be characterized by:
    - ✓ Prevention of restenosis
    - ✓ Inexpensive catheterization procedure on an out-patient basis
  - ◆ We are also extending this procedure to treat older, non-coated stents





## Future R&D

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- Comprehensive test program with partner in the medical community
- Future enhancement/extension:
  - ◆ possible extension to stents
  - ◆ Initiated test with stent in phantom material
- Remaining milestones
  - ◆ Test in extracted tissue
  - ◆ High fidelity computational model





## IP Status

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- 5 U.S. patents issued
- NASA Partnership Options
  - ◆ Space Act Agreement
    - ✓ Cooperative effort to mature the technology
  - ◆ Eventual licensing of technology